Model 926
ADCAM® Multichannel Buffer
Hardware Manual

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Manual Revision G

Advanced Measurement Technology, Inc.

a/k/a/ ORTEC®, a subsidiary of AMETEK®, Inc.

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Before being approved for shipment, each ORTEC instrument must pass a stringent set of quality control tests designed to expose any flaws in materials or workmanship. Permanent records of these tests are maintained for use in warranty repair and as a source of statistical information for design improvements.

Repair Service

If it becomes necessary to return this instrument for repair, it is essential that Customer Services be contacted in advance of its return so that a Return Authorization Number can be assigned to the unit. Also, ORTEC must be informed, either in writing, by telephone [(865) 482-4411] or by facsimile transmission [(865) 483-2133], of the nature of the fault of the instrument being returned and of the model, serial, and revision ("Rev" on rear panel) numbers. Failure to do so may cause unnecessary delays in getting the unit repaired. The ORTEC standard procedure requires that instruments returned for repair pass the same quality control tests that are used for new-production instruments. Instruments that are returned should be packed so that they will withstand normal transit handling and must be shipped PREPAID via Air Parcel Post or United Parcel Service to the designated ORTEC repair center. The address label and the package should include the Return Authorization Number assigned. Instruments being returned that are damaged in transit due to inadequate packing will be repaired at the sender's expense, and it will be the sender's responsibility to make claim with the shipper. Instruments not in warranty should follow the same procedure and ORTEC will provide a quotation.

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Shipments should be examined immediately upon receipt for evidence of external or concealed damage. The carrier making delivery should be notified immediately of any such damage, since the carrier is normally liable for damage in shipment. Packing materials, waybills, and other such documentation should be preserved in order to establish claims. After such notification to the carrier, please notify ORTEC of the circumstances so that assistance can be provided in making damage claims and in providing replacement equipment, if necessary.

CONTENTS

SAFETY INSTRUCTIONS AND SYMBOLS

This manual contains up to three levels of safety instructions that must be observed in order to avoid personal injury and/or damage to equipment or other property. These are:

DANGER Indicates a hazard that could result in death or serious bodily harm if the safety instruction is not observed.

WARNING Indicates a hazard that could result in bodily harm if the safety instruction is not observed.

CAUTION Indicates a hazard that could result in property damage if the safety instruction is not observed.

Please read all safety instructions carefully and make sure you understand them fully before attempting to use this product. In addition, the following symbol may appear on the product:

⚠ **ATTENTION – Refer to Manual**

⚠ **DANGER – High Voltage**

Please read all safety instructions carefully and make sure you understand them fully before attempting to use this product.

SAFETY WARNINGS AND CLEANING INSTRUCTIONS

DANGER	Opening the cover of this instrument is likely to expose dangerous voltages. Disconnect the instrument from all voltage sources while it is being opened.

WARNING	Using this instrument in a manner not specified by the manufacturer may impair the protection provided by the instrument.

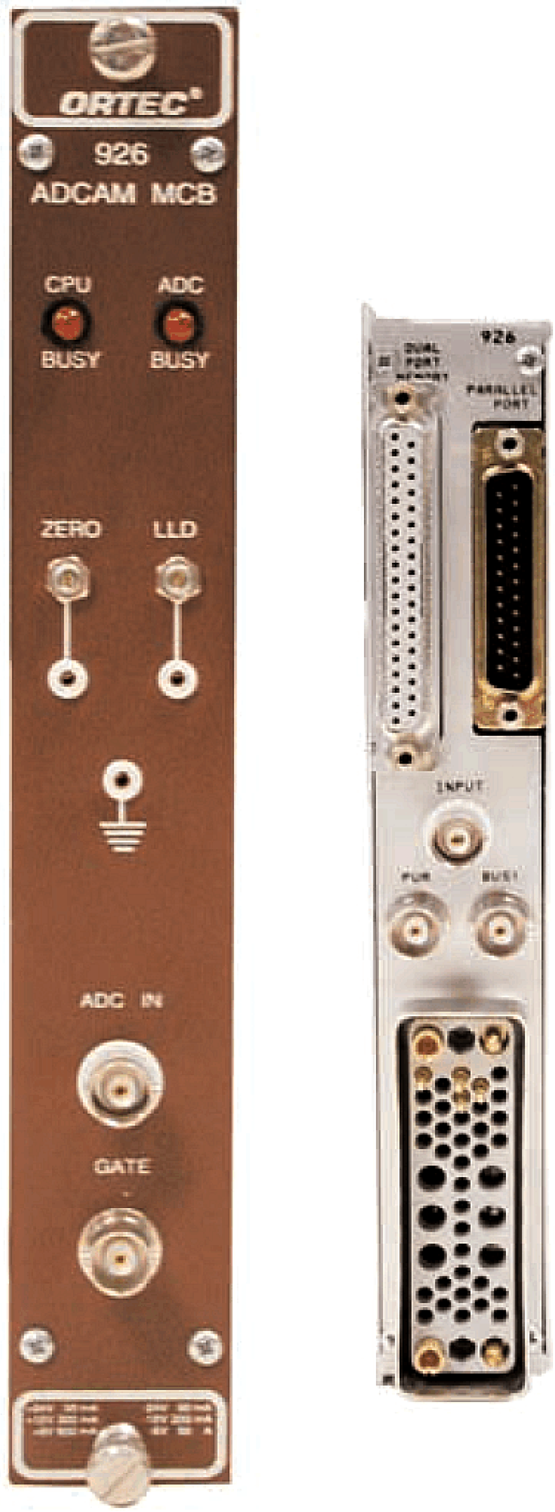
Cleaning Instructions

To clean the instrument exterior:

- Unplug the instrument from the ac power supply.
- Remove loose dust on the outside of the instrument with a lint-free cloth.
- Remove remaining dirt with a lint-free cloth dampened in a general-purpose detergent and water solution. Do not use abrasive cleaners.

CAUTION	To prevent moisture inside of the instrument during external cleaning, use only enough liquid to dampen the cloth or applicator.

- Allow the instrument to dry completely before reconnecting it to the power source.


ORTEC
926
ADCAM MCB
CPU
BUSY
ADC
BUSY
ZERO
LLD
ADC IN
GATE
926
DUAL PORT MEMORY
PARALLEL PORT
INPUT
PUR
BUSY

ORTEC MODEL 926
ADCAM MULTICHANNEL BUFFER

1. DESCRIPTION

1.1. GENERAL

The ORTEC Model 926 Multichannel Buffer (MCB) is a NIM module designed for high-performance data acquisition in nuclear spectroscopy applications. ORTEC offers MCA emulation software and quantitative analysis software for almost every application.

The Model 926 can be configured to connect to a PC with our DPM-USB Dual-Port-Memory-to-USB Interface Converter, or via the legacy parallel printer-port interface. The DPM-USB converter (one converter per 926 unit) makes it simple to connect multiple 926s and other ORTEC USB MCBs to the host PC's native USB ports and/or powered USB hubs. You can also connect a daisy chain of 926s to the PC's printer port.

1.2. INTENDED AUDIENCE

This manual describes the initial installation and setup of the Model 926. Section 2 gives the Model 926 specifications for reference. Section 3 tells how to install and configure the Model 926. Section 4 describes the basics of MCA operation. Section 5 gives some troubleshooting information. The appendix is intended for the user who wishes to write custom software to control the Model 926. IT explains the commands used to control the system.

2. SPECIFICATIONS

2.1. PERFORMANCE

ADC Successive-approximation type with sliding-scale linearization.

Max Resolution Software selectable as 8192, 4096, 2048, 1024, and 512.

Dead Time per Event 8 µs, including memory transfer.

Integral Nonlinearity ≤±0.025% over the top 99% of the dynamic range.

Differential Nonlinearity <±1% over the top 99% of the dynamic range.

Gain Instability ≤±50 ppm/°C.

Dead-Time Correction Printed wiring board jumper selects either Extended Live-time correction according to the Gedcke-Hale method,[1] or Simple Live-Time correction with the clock turned off during the conversion time.

Data Memory 8K channels of battery backed-up memory; 2^{31}-1 counts per channel (over 2 billion).

Presets
- **Real Time/Live Time**: Multiples of 20 ms.
- **Region-of-Interest**: Peak count/Integral count.
- **Data Overflow**: Terminates acquisition when any channel exceeds 2^{31}-1.

Microprocessor Intel 80C188; 32K Dual-Port RAM with battery backup; 16K "scratchpad" RAM with battery backup. 32K program memory.

2.2. INDICATORS AND CONTROLS

CPU BUSY Red, busy-rate LED; intensity indicates the relative activity of the microprocessor.

ADC BUSY Red, busy-rate LED flashes once for each pulse digitized by the ADC.

ADC ZERO Front-panel screwdriver potentiometer, ±250 mV.

ADC LLD Front-panel screwdriver potentiometer, from 0 to 10% full scale.

[1]Ron Jenkins, R.W. Gould, and Dale Gedcke, *Quantitative X-Ray Spectrometry* (New York: Marcel Dekker, Inc.), 1981, pp. 266–267.

2.3. INPUTS

INPUT Accepts positive unipolar, positive gated integrator, or positive-leading bipolar analog pulses in the dynamic range from 0 to +10 V; +12 V maximum; semi-Gaussian-shaped or gated-integrator-shaped time constants from 0.25 to 30 μs, or delay-line-shaped with width >0.25 μs. $Z_{in} \approx 1$ kΩ, dc-coupled. No internal delay. BNC connectors on front and rear panels.

ADC GATE Optional, slow-positive NIM input. Computer-selectable Coincidence or Anticoincidence. Signal must occur prior to and extend 0.5 μs beyond the peak of the pulse; front-panel BNC connector. $Z_{in} \sim 1$ kΩ.

PUR Pile-up rejection input; accepts slow-positive NIM signal; signal must occur prior to peak detect. $Z_{in} > 1$ kΩ. BNC connector on rear panel.

BUSY Busy input used by live-time correction circuits. Accepts slow-positive NIM signal; signal must occur prior to peak detect. $Z_{in} > 1$ kΩ. BNC connector on rear panel.

2.4. INTERFACE CONNECTORS

PARALLEL PORT Provides for control of the instrument and access to the data memory from a standard PC printer port. Rear-panel mounted, 25-pin D-shaped male connector.

PRINTER Optional connection provided to either connect to another 926 MCB or a printer to the system. Rear-panel mounted, 25-pin D-shaped female connector.

DUAL-PORT MEMORY Optional 37-pin D connector provides the PC with a communication link and direct access to the Model 926's internal data memory. The DUAL-PORT MEMORY connector replaces the PRINTER connector on the rear panel when installed.

2.5. ELECTRICAL AND MECHANICAL

POWER REQUIRED +12 V, 200 mA; -12 V, 200 mA; +6 V, 600 mA.

WEIGHT Net 0.9 kg (2 lb), Shipping 2.25 kg (5 lb).

DIMENSIONS NIM-standard single-wide 3.43 x 22.13 cm (1.35 x 8.714 in.) front panel per DOE/ER-0457T.

3. INSTALLATION

1. Install the accompanying version of our MAESTRO®-32 MCA Emulation Software (and the CONNECTIONS-32 Update Kit, if included) according to its instructions. Depending on the 926-to-PC interface you will use, mark the appropriate checkbox on the installation wizard's Instrument Family page as follows:

   - If using a DPM-USB interface converter to attach the 926 to the PC, mark the **DPM-USB** checkbox.

   - If connecting via the printer port, mark the **DART or any other printer-port based device** checkbox.

2. Select the live-time correction mode (Section 3.1).

3. If using a DPM-USB interface converter, the MCB address must be set to the factory default of 1. If this is a new instrument, it is ready to use without modification. Install the DPM-USB converter according to its instructions.

4. If connecting via the printer port, see Section 3.3 for instructions on setting the MCB/PRN addressing jumper.

5. To switch between the DPM and printer-port interfaces, see Section 3.4.

6. Cable the spectroscopy system together and connect it to the PC.

7. Power on the 926. If the Windows "found new hardware" wizard opens, follow the prompts, choosing (a) to ***not go to the internet*** to find the driver, and (b) to ***automatically*** locate the driver. If the wizard cannot locate the driver, direct it to **C:\Program Files\Common Files\ORTEC Shared\UMCBI**.

8. Run the MCB Configuration program to build the list of available MCBs, according to the MAESTRO *User's Manual*.

9. To adjust the lower-level discriminator and the zero level, see Sections 3.6 and 3.7, respectively. Section 3.8 describes the gate input.

3.1. LIVE-TIME MODE

The Model 926 has two different live-time correction modes: Extended and Simple. The Extended mode is the Gedcke-Hale correction mode which corrects for losses caused by pileup in the shaping amplifier. This is the default setting and is usually the correct setting for energy spectroscopy systems. The Simple Live-Time correction mode simply stops the live-time clock when the BUSY signal is active, the Model 926 detects that a pulse is arriving at its input, or the 926 is busy digitizing data. The Simple Live-Time mode is appropriate only in very specialized situations and is not the correct setting for most users.

To change the live-time correction mode, remove the right side plate of the Model 926 by removing the four screws. Figure 2 shows the location of the live-time correction mode jumper. Place the jumper across the lower two pins for Extended Live-Time correction and across the upper two pins for Simple Live-Time correction.

3.2. MCB ADDRESS

The Model 926 can be installed in a system with multiple ORTEC MCBs. However, to prevent hardware conflicts when using older MCBs it might be necessary for you to manually change the MCB address for one or more instruments.

If connecting to your PC with a DPM-USB interface converter, no MCB address change is needed; leave the unit's address at the factory default setting of 1. If changing older 926s from the legacy DPM ribbon cable interface to the DPM-USB converter, make sure each unit is set to address 1. MAESTRO and other CONNECTIONS-32 programs support a maximum of 127 USB connections.

If connecting multiple 926s via the printer port, every MCB in the system must be assigned a unique MCB address. (You may find it useful to mark the front panel of each instrument with its MCB address.) Figures 3 and 4 show two printer-port systems with the jumper settings for the various 926s.

Once an address is established for each MCB in the system, the hardware must be set to that address. On the Model 926 the address is set with the rotary switch highlighted in Fig. 2. To access this switch, remove the right side plate. The switch should be set to 1 less than the MCB address. For example if the MCB address is 1, set the switch to 0.

3.3. MCB/PRN JUMPER FOR PRINTER-PORT CONNECTIONS

The MCB/PRN jumper must be correctly set when the printer-port interface is used.

To connect an MCB only — If the jumper is in the MCB position, an MCB can be connected to the PRINTER connector.

To connect a printer and MCB — If the jumper is in the PRN position, a printer can be connected to the PRINTER connector on the rear panel of the Model 926.

The jumper is set to MCB when the Model 926 leaves the factory. To change the MCB/PRN jumper, remove the right side plate of the Model 926 by removing the four screws. Figure 1 shows the location of the jumper. Place the jumper across the right two pins for PRN and across the left two pins for MCB.

Figures 3 and 4 show how the MCB/PRN jumper should be set for a single-MCB and a multi-MCB system.

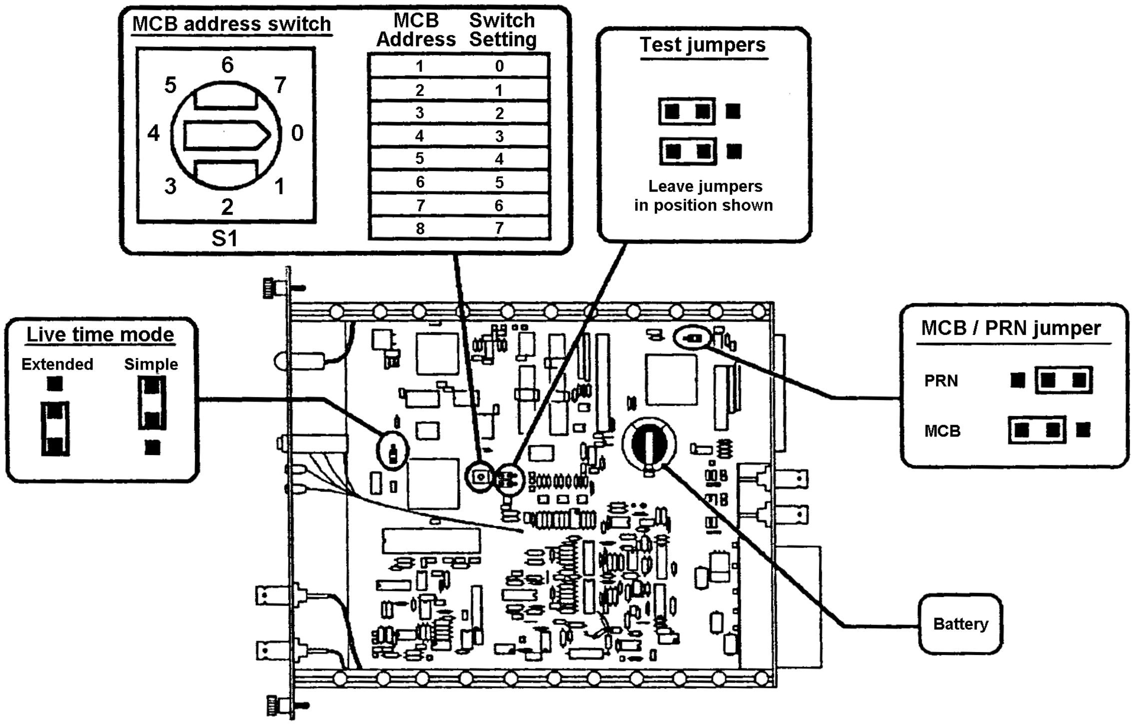


Fig. 2. Model 926 Address Switch and Jumpers.

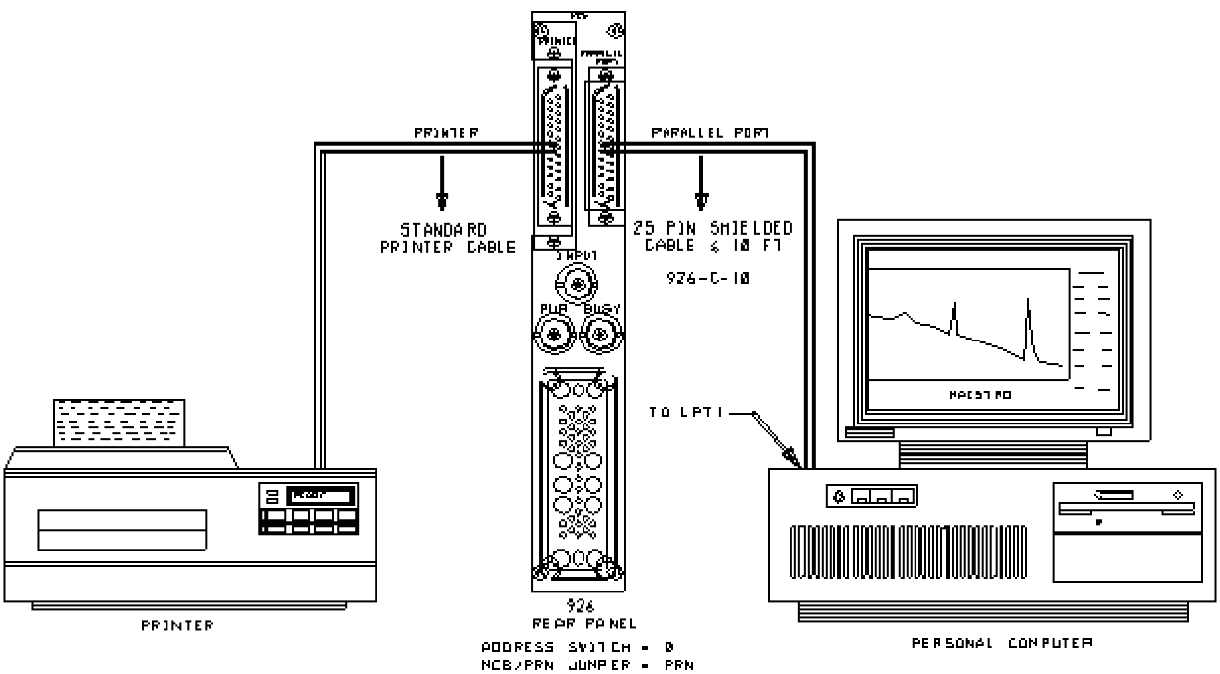


Fig. 3. Single Model 926 Using Printer-Port Interface.

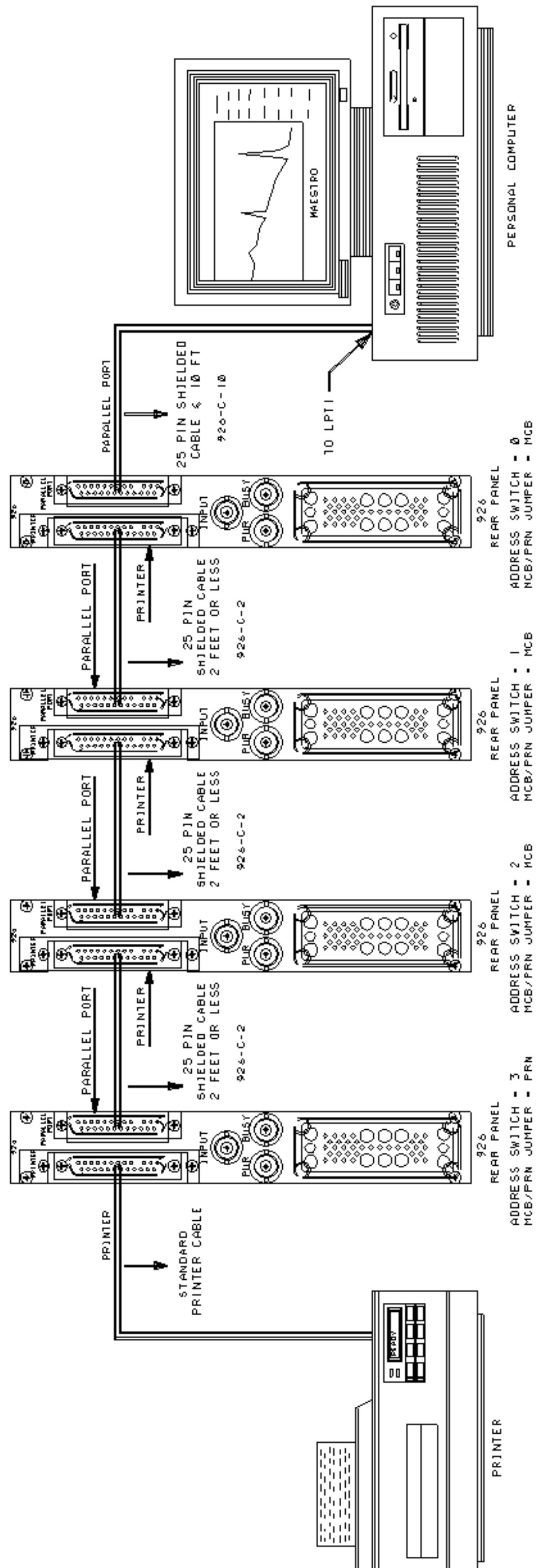


Fig. 4. Printer Port System with Four 926s.

3.4. PRINTER-PORT VS DUAL-PORT MEMORY INTERFACE

You can purchase the Model 926 pre-set for use with either the DPM-USB Dual-Port-Memory-to-USB Interface Converter or the printer-port interface. The DPM-USB converter requires that the Dual-Port-Memory Interface option be installed. If your 926 is configured for the Dual-Port Memory Interface and you wish to convert to the printer-port interface, see Section 3.4.1. If the unit is configured for the printer-port interface and you wish to convert to the Dual-Port Memory Interface, see Section 3.4.2.

3.4.1. Installing the Printer-Port Interface

If the Dual-Port Memory Option has been installed in the 926, the Printer Option must be reinstalled if a printer or second MCB is to be connected to the 926. To install the Printer Option do the following:

1. Remove the right side plate by removing the four screws which hold it in place.
2. Using a 3/16" nut driver, remove the two hex nuts which hold the Dual-Port Memory (DPM) connector to the rear panel.
3. Slide the connector out of the rear-panel slot.
4. Disconnect the DPM cable from the Model 926 board by pulling straight up on the header which connects the DPM cable to the board.
5. Store the cable, hex nuts, and washers in a safe place.
6. Carefully plug the Printer Option in to the row of pins close to the rear panel (see Figure 4). The connector is keyed for proper installation.
7. Slide the other end of the cable into the rear panel of the 926. Secure the connector with two screws.
8. Replace the side plate.

Figures 3 and 4 show wiring diagrams for several printer port systems. The cables used are 25-pin shielded male-female cables. The cable from the computer to the first Model 926 should be no longer than 10 feet (3 meters). Cables connecting additional 926s should be no longer than 2 feet (0.6 meters). These cables are available from ORTEC by ordering Model 926-C-10 for a 10-foot cable and Model 926-C-2 for a 2-foot cable. The cable used to connect a Model 926 to a printer is a standard printer cable which normally connects a computer to a printer.

3.4.2. Installing the Dual-Port Memory Interface

If your 926 is configured for the printer-port interface and you wish to use the Dual-Port Memory interface instead, two steps are necessary: the instrument must be reconfigured and you must purchase either the DPM-USB Dual-Port-Memory-to-USB Interface Converter or the classic Dual-Port Memory Interface ribbon cable from ORTEC.

To reconfigure the 926, you must install the Dual-Port Memory Option, which is included with each 926. It is a 37-pin ribbon cable with a 37-pin D connector on one end and a 40-pin header on the other end. To install the Dual-Port Memory Option, do the following, referring to Fig. 5:

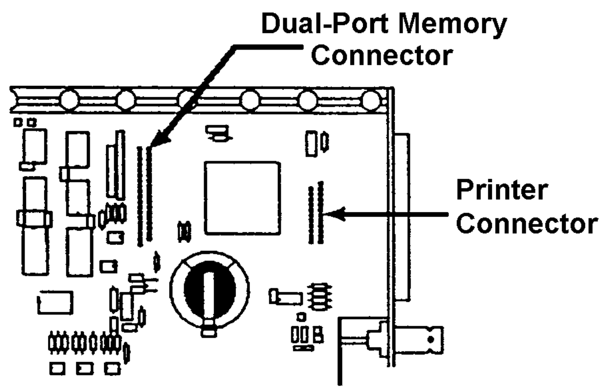


Fig. 5. Location of Option Connectors.

1. Remove the right side plate by removing the four screws which hold it in place.
2. Remove the two Phillips screws that hold the PRINTER panel in place.
3. Slide the PRINTER panel out of the rear-panel slot.
4. Disconnect the PRINTER option from the Model 926 board by pulling straight up on the header which connects the ribbon cable to the board.
5. Store the cable and screws in a safe place.
6. Carefully plug the Dual-Port Memory option
7. Slide the connector into the rear panel of the 926. Secure the connector with 3/16" hex nuts and washers provided.
8. Replace the side plate.

3.5. CABLING A SYSTEM

The standard cabling of a 926 in a HPGe detector system is shown in Fig. 6.

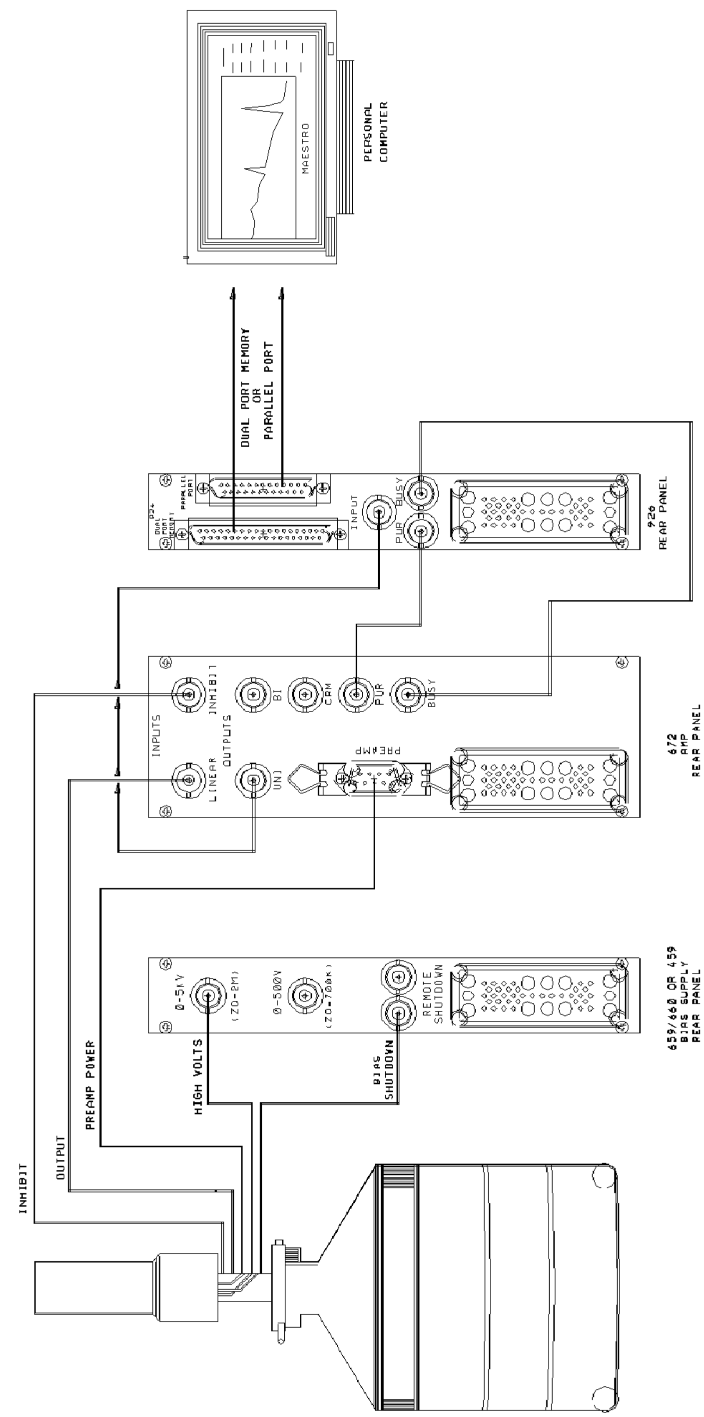


Fig. 6. HPGe Cabling Diagram.

If the detector has a TRP preamplifier ("-PLUS" model), all connections shown should be made. If the preamplifier is a resistive-feedback preamplifier, the INHIBIT OUTPUT does not exist, so the connection to INHIBIT is not made. (INHIBIT is left open.)

3.6. ADJUSTING THE LOWER-LEVEL DISCRIMINATOR

The Lower-Level Discriminator (LLD) adjustment is used to prevent small noise pulses from being converted by the ADC. Converting the noise pulses, causes the ADC to incur a large amount of dead time, thereby preventing the ADC from converting the actual pulses of interest. When the Model 926 is shipped from the factory, the LLD setting is approximately 75 mV, so no pulses smaller than 75 mV are converted or histogrammed. This setting is adequate for most systems.

If the system has high noise or there is a very low energy peak in the spectrum, it may be advantageous to adjust the LLD setting. In the high noise system, start collecting data and observe the dead time on the screen along with the number of counts arriving at the low end of the spectrum. With a small screwdriver, turn the LLD adjustment on the front panel clockwise, until the dead time drops or the peaks due to noise at the low end of the spectrum stop getting new counts. If there is a low energy peak in the spectrum, it may be necessary to lower the LLD setting to prevent the peak from being rejected. Start data acquisition and observe the low end of the spectrum while turning the LLD adjustment on the front panel counterclockwise. Continue the adjustment until the peak is in the spectrum. *Caution: Do not lower the adjustment such that the dead time goes to 100%.*

3.7. SETTING THE ZERO ADJUSTMENT

The Zero Adjustment is provided to add or subtract a dc level from the input signal. The Zero Adjustment is on the front panel of the Model 926. Usually no zero adjustment is required or recommended, since most modern spectroscopy amplifiers have very little dc offset. Should offset adjustment be necessary, turn the screwdriver adjustment clockwise to move peaks in the spectrum to the right and counterclockwise to move them to the left.

3.8. ENABLING THE GATE INPUT

The Gate on the front panel operates in one of three modes:

- *Off* — The Gate Input does nothing.
- *Coincidence* — For a pulse to be converted, the Gate Input must be active (>2.5 V) when the pulse reaches its peak and for 0.5 μs thereafter.
- *Anticoincidence* — For a pulse to be converted, the Gate Input must be inactive (<0.8 V) when the pulse reaches its peak and for 0.5 μs thereafter.

When the Model 926 is shipped from the factory, the Gate Input is set *Off*. To change the Gate Input mode, a SET_GATE command must be sent to the 926. This command can be sent within MAESTRO-32 by creating an ASCII-text .JOB file.

Create a .JOB file as follows to set the gate to Coincidence:

1. Go to the **Services** menu.
2. Select **Job Control**.
3. Select **Edit File** (takes you to Notepad).
4. Type:

SEND_MESSAGE "SET_GATE_COIN" ↩

5. Save as COIN.JOB then exit Notepad.
6. Refresh display by reentering **Job Control**.
7. Select COIN.JOB and click on **OK**.

To set gate to *Anticoincidence* or to disable the GATE, replace COIN in Steps 4 and 5 with ANTI or OFF. Refer to the MAESTRO *User's Manual* for more information on creating .JOB files. The Gate Mode setting is stored in the 926's memory, so the command or .JOB file need only be executed once, unless the battery fails.

4. MCA BASICS

The first half of this section describes the circuitry found on the Model 926 board (MCB) while the second half describes the dead-time effects encountered in an MCA.

4.1. MCB OPERATION

This section contains a very basic description of the input circuitry and the chain of events that occurs in the Model 926 when an input pulse arrives to be histogrammed. Figure 7 shows the basic block diagram of the input section of the Model 926. First a description of each block in the circuit:

- **Buffer** — The buffer is provided to properly match impedances between the input and the Model 926 circuitry.

- **Linear Gate** — The Linear Gate protects the peak stretcher during conversion of an event. When the Linear Gate is "open," its output is identical to its input. When the Linear Gate is "closed," its output is always zero.

- **Peak Stretcher** — The peak stretcher operates in one of two modes: Track or Hold. In Track mode, the output of the peak stretcher is identical to its input. In Hold mode, the peak stretcher acts like a maximum function. It outputs the maximum value which is applied to the input. The Peak Stretcher also has a Peak Detect output which goes active when its output is greater than the value at its input.

- **Analog-to-Digital Converter** — The Analog-to-Digital Converter (ADC) takes an analog signal and converts it to a digital equivalent.

- **Zero-Level, Lower-Level, and Upper-Level Discriminators** — The discriminators provide 3 control signals which help control the conversion process. The Zero-Level Discriminator (ZLD) is active, when the input signal is greater than 1/2 of the Lower-Level Discriminator setting. The Lower-Level Discriminator (LLD) is active, when the input signal is greater than the Lower-Level Discriminator setting. The Upper-Level Discriminator (ULD) is active when the input signal is greater than the maximum possible ADC output. The Lower-Level Discriminator settings is set with a screwdriver adjustment on the front panel.

- **ADC Control** — This circuit accepts all of the various status signals and provides the control signals required to complete a conversion.

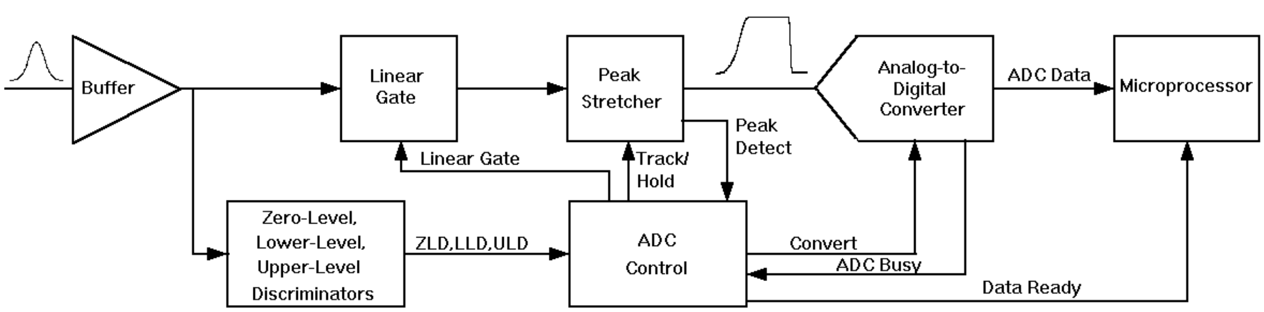


Fig. 7. Model 926 Input Block Diagram.

- Microprocessor — The microprocessor accepts the digital data and adds it to the spectrum.

Upon arrival of an input pulse, the sequence of events is as follows:

- ZLD goes active when the input reaches 1/2 of the LLD setting.

- When ZLD goes active, the peak stretcher is switched to Hold mode.

- When Peak Detect goes active, LLD, PUR, GATE, and ULD are sampled. If any of these signals rejects the pulse, then the Peak Stretcher is returned to Track mode. If the pulse is accepted, the Linear Gate is closed and the ADC is given the convert signal.

- When the ADC is finished converting, the data is transferred to the microprocessor for histogramming, the Linear Gate is opened, and the Peak Stretcher is returned to Track mode.

4.2. DEAD TIME IN MCA AND AMPLIFIER

When a detector, preamplifier, spectroscopy amplifier, and MCA are combined to form a spectroscopy system, the dead times of the amplifier and the MCA are in series (see Fig. 8). The combination of the amplifier extending dead time followed by the MCA non-extending dead time T_M yields a throughput described by:

$$r_0 = \frac{r_i}{\exp[r_i(T_W + T_P)] + r_i[T_M - (T_W - T_P)]U[T_M - (T_W - T_P)]}$$

The rate of events arriving at the detector is r_i, and r_o is the rate of analyzed events in the MCA spectrum. T_W is the width of the amplifier pulse at the noise discriminator threshold (Figure 7). T_P is the time from the start of the amplifier pulse to the point at which the MCA detects peak amplitude and closes the linear gate. $U[T_M - (T_W - T_P)]$ is a unit step function that changes from 0 to 1 when T_M is greater then $(T_W - T_P)$. T_M is the conversion time of the ADC and includes the time required to transfer the data to the subsequent memory.

The 926 Extended Live Timer utilizes the Gedcke-Hale method to correct for the dead-time losses implied by the equation above. When the counts in a full-energy peak are divided by the live time, the resulting counting rate is an accurate estimate of the true counting rate for that gamma-ray energy at the detector output. The Gedcke-Hale method uses the amplifier analog output, BUSY and PUR (Pile-Up-Reject) signals. The amplifier dead time is combined with the ADC conversion and readout dead time to obtain the overall system dead time. For accurate live time, the PUR and BUSY signals must be connected from the amplifier to the 926.

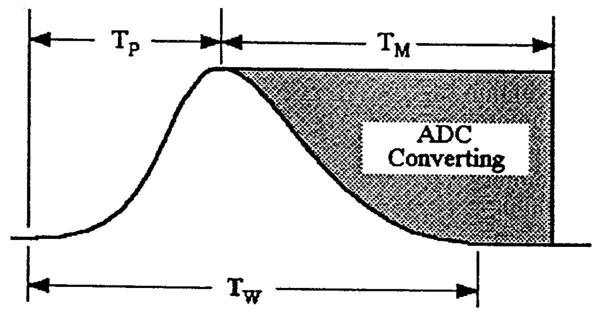


Fig. 8. The Sources of Dead Time with an Amplifier and MCA.

The Gedcke-Hale live-time clock works as follow:

- Either the leading edge of the amplifier BUSY signal or the crossing of the ADC Lower-Level Discriminator (LLD) by the ADC input causes the live-time clock to start counting backwards.

- The live-time clock is turned off by the ADC peak detect or by the amplifier PUR signal.

- The live-time clock resumes counting forward after all of the following signal conditions are satisfied:

  — The ADC conversion and readout is complete.
  — The ADC input has returned below the LLD threshold.
  — The PUR and BUSY signals have returned to the inactive state.

Turning off the live-time clock compensates for the probability of losing a second pulse during the processing of the first pulse. Subtracting live time compensates for the probability of losing two pulses when the second pulse distorts the amplitude of the first pulse.

5. TROUBLESHOOTING GUIDE

This section of the manual contains some troubleshooting hints to help when something goes wrong. Below are listed several common problems and possible solutions:

5.1. DUAL-PORT MEMORY DOES NOT EXIST

- Carefully review the instructions in Section 3.2 and ensure that the MCB address has been properly set.

5.2. BATTERY BACKUP FAILS

The memory in the Model 926 has battery backup to maintain data when power is turned off. The battery used is a lithium battery with a nominal voltage of 3 V.

To replace battery: Remove the right-side plate. Locate battery on the top right corner of the 926 (see Figure 1). Remove the old battery from the holder and slide a new one in. It may be necessary to bend the battery holder down after removing the old battery to get good contact with the new battery.

BATTERY SPECIFICATION: Lithium coin cell, P/N 739480.

APPENDIX A. FIRMWARE COMMANDS AND RESPONSES

Software communication with the DSPEC Pro takes place through the CONNECTIONS-32 software layer. CONNECTIONS-32 is used by all ORTEC software and can be accessed for other software development with our CONNECTIONS-32 Programmer's Toolkit with Microsoft ActiveX® Controls (A11-B32).

A.1. CONNECTIONS-32

In CONNECTIONS-32, the communication consists of sending command records to the MCB API and receiving response records from the MCB API. Both command and response records consist of a sequence of printable ASCII characters followed by an ASCII carriage return. The single exception to this rule is the "#B" response record for the WRITE command, which contains binary integer numbers. All commands eventually respond with a percent response record (so named because the response begins with an ASCII percent sign "%") which signifies the completion of the command. SHOW and STEP commands respond with a dollar response record (which begins with an ASCII dollar sign "$") followed by a percent response record. The WRITE command can respond with multiple pound sign records (which begin with an ASCII pound sign "#") but eventually completes by sending a percent response record. All other commands result in a single percent response record upon completion.

A.2. COMMAND RECORDS

The Model 926 commands consist of a command header, which may be followed by numeric parameter values. The header consists of a verb or a verb and noun separated by an underscore or a verb, noun, and modifier, each separated by underscores. The verbs, nouns, and modifiers in the command header are mnemonic words such as the verb ENABLE or the noun OVERFLOW that relate to the function performed by the MCB when it executes the command. The first four letters of any word will always be enough to uniquely identify the word when composing commands for an MCB. For example, the command **ENABLE_OVERFLOW_PRESET** can be abbreviated to **ENAB_OVER_PRES**.

Numeric parameters are unsigned integer numbers that follow the command header separated by one or more spaces. Specific commands require up to three parameters, separated by commas, which specify numeric quantities related to the operation of the MCB, such as live time or conversion gain. The command **SET_WINDOW 0,8192** has two parameters, 0 and 8192, which set the window-of-interest to start at channel 0 and continue for 8192 channels.

Some parameters listed in the command dictionary are considered optional and are distinguished from mandatory parameters by being surrounded by brackets in the command prototype line (e.g.,

SET_WINDOW [start,length]). Commands that have optional parameters may be sent to the MCB without the optional parameters, in which case the behavior will be changed as explained in the command description.

An optional checksum may be added to the end of any command sent to an MCB. The checksum is a 1-byte unsigned integer sum of all of the characters in a command, treated as unsigned integers, up to and including the comma or space(s) that separates the checksum from the command. The checksum simply appears as an extra parameter added to the end of the command parameter list. For commands that do not normally have parameters, the checksum appears as the only parameter separated from the header by one or more spaces. All optional parameters must be included in a command if a checksum is to be provided so that the checksum is not mistaken by the MCB as a parameter. For example, the SET_WINDOW command must include the two optional parameters, start and length, if the checksum is provided (e.g., **SET_WINDOW 0,8192,159**).

A.3. PERCENT RESPONSE RECORDS

The 926 MCBs respond to all commands with a percent response record that signifies the completion of the command. Percent response records contain two error code numbers and a 1-byte checksum as follows:

%aaabbbccc<CR>

where % represents the ASCII % character, **aaa** represents the macro error code, **bbb** represents the micro error code, **ccc** represents the checksum, and <CR> represents the ASCII carriage return character signifying the end of the record. The macro error code represents the general class of error with 0 meaning no error, and the micro error code represents the sub-class of error with 0 meaning no error. The following table lists all percent responses for a Model 926:

Unconditional Success:	%000000069	No Errors Detected.
START/STOP Warnings:	%000005074	MCB already started or stopped.
	%000006075	Preset already exceeded.
Power-Up Alert:	%001000070	All power-up selftests passed.
	%003000072	Battery backed-up data lost
	%005002076	ROM failed selftest
TEST Command Results:	%004002075	ROM failed selftest
	%004008081	Processor memory failed selftest
	%004016080	Dual-Port memory failed selftest
	%004010074	ROM and Processor memory failed selftest
	%004018082	ROM and Dual-Port memory failed selftest
	%004024079	Processor and Dual-Port memory failed
	%004026081	ROM, processor memory, and Dual-Port failed
Command Syntax Errors:	%129001082	Invalid verb in command
	%129002083	Invalid noun in command
	%129003084	Invalid verb and noun in command
	%129004085	Invalid modifier in command
	%129005086	Invalid verb and modifier in command
	%129006087	Invalid noun and modifier in command
	%129007088	Invalid verb, noun and modifier in command

	%129132087	Invalid command (verb, noun, and modifier valid, but not together)
Communication Errors:	%130128084	Incorrect checksum (only if checksum provided)
	%130129085	Command record too long
Execution Errors:	%131128085	Invalid 1st parameter
	%131129086	Invalid 2nd parameter
	%131130078	Invalid 3rd parameter
	%131132080	Invalid number of parameters
	%131135083	Illegal command while acquisition is in progress
	%131136084	Illegal command in current mode of operation

A.4. DOLLAR RESPONSE RECORDS

SHOW commands respond with a single dollar response record followed immediately by a percent response record. All valid dollar response records for each command are listed in the command dictionary.

The following table lists the general form of each dollar response record for a 926 MCB. In this table lowercase letters represent numeric values. The letters "**ccc**" always represent an 8-bit unsigned checksum of all characters on the record up to but not including the checksum characters, and **<CR>** represents the ASCII carriage return character.

Response	Description
$Axxxccc	xxx is an 8-bit unsigned number
$Cxxxxxccc	xxxxxx is a 16-bit unsigned number
$Dxxxxxyyyyyccc	xxxxx and yyyyy are 16-bit unsigned numbers
$Exxxxxccc	xxxxx is a 16-bit alarm mask
$Fsssss...	ssss... is a variable length ASCII character sequence (No checksum is sent with this record)
$Gxxxxxxxxxxccc	xxxxxxxxxx is a 32-bit number
$IT	True response to a SHOW command (no checksum)
$IF	False response to a SHOW command (no checksum)
$Jxxxxxyyyyy...ccc	Response to SHOW_CONFIG command.
$Mxxxxxxxxxx...ccc	Response to SHOW_STATUS command.
$Nxxxyyyzzzccc	xxx,yyy and zzz are 8-bit unsigned numbers.

A.5. COMMAND CATALOG

This section lists each Model 926 command with a description of its operation. The descriptions include a list of any unusual responses that may result. As described in previous sections, the usual response from a command is a **%000000069<CR>** response, which represents a macro error code of 0 and a micro error code of 0 (no errors).

All execution error responses, if any, are listed for each command. Though syntax and communication error responses may result from any command, in practice, these error responses rarely occur on systems with reliable communication hardware running debugged software. Refer to the section on Percent Response Records in this Appendix for information about error responses.

In the following catalog the commands are listed in alphabetical order, each starting with a command prototype line. Uppercase letters, numeric digits, blank space, and special symbols such as the underscore "_" and comma "," in the prototype line are literal text to be sent to the MCB exactly as it appears. Lowercase letters in the prototype line represent numeric values as described in the accompanying text and should not be sent literally to the MCB but should be replaced by an appropriate numeric value. Items in the command prototype that are surrounded by brackets "[...]" are optional items and are not always required.

In this section the term **<CR>** represents the ASCII carriage return character, decimal value 13, and the character "_" represents the ASCII underscore character, decimal value 95.

CLEAR

The channels of spectral data in the window-of-interest (see SET_WINDOW command) are set to zero. The live-time and true-time counters are also set to zero. This command is equivalent to the combination of CLEAR_COUNTERS and CLEAR_DATA commands.

CLEAR_ALL

This command is equivalent to the combination of CLEAR_COUNTERS, CLEAR_DATA, CLEAR_PRESETS, and CLEAR_ROI commands.

<u>Execution Errors:</u>

%131135083<CR> The command was attempted while spectrum acquisition was in progress. No action was taken.

CLEAR_COUNTERS

The live-time and true-time counters are set to zero.

CLEAR_DATA

The channels of spectral data in the window-of-interest (see SET_WINDOW command). The ROI flags are not changed, nor are the presets changed.

CLEAR_PRESETS

The live time, true time, ROI integral, ROI peak, and overflow presets are all set to zero (disabled).

<u>Execution Errors:</u>

%131135083 The command was attempted while spectrum acquisition was in progress. No action was taken.

CLEAR_ROI

The region-of-interest flags for the channels in the window-of-interest (see SET_WINDOW command) are cleared.

<u>Execution Errors:</u>

%131135083 The command was attempted while spectrum acquisition was in progress. No action was taken.

DISABLE_ALARM

Ends the transmission of alarm responses when acquisition stops. See also ENABLE_ALARM and SHOW_ALARM.

DISABLE_OVERFLOW_PRESET

Disables the overflow preset. Channels that receive a count when they contain 2147483647 counts, the maximum number of counts, will roll over to zero counts if the overflow preset is disabled. See also ENABLE_OVERFLOW_PRESET and SHOW_OVERFLOW_PRESET.

ENABLE_ALARM

Begins the transmission of alarm responses, $E records, when an input stops counting. A $E response record will be transmitted only when no host commands are being processed (after a % response from a previous command and before another command is sent). See also DISABLE_ALARM and SHOW_ALARM.

ENABLE_OVERFLOW_PRESET

Enables the overflow preset. Channels that receive a count when they contain 2147483647 counts, the maximum number of counts, will stop the acquisition for that channel's device if the overflow preset is disabled. The channel that caused the preset to complete will contain 214783647 counts. An alarm response record will be sent to the host if alarms are enabled (see ENABLE_ALARM command). See also DISABLE_OVERFLOW_PRESET and SHOW_OVERFLOW_PRESET commands.

INITIALIZE

Resets the Model 926 hardware and software as though the following commands had been issued:

STOP	SET_WINDOW 0,8192
SET_GATE_OFF	TEST 1
CLEAR_ALL	SET_GAIN_CONVERSION 0

Execution Errors:

The INITIALIZE command simulates a power-down/power-up cycle for the MCB after a simulated loss of battery backed-up memory. Thus the % response record is the response from the Power-Up Alert.

%003000072<CR>	MCB Power-up occurred/Memory lost/No selftest errors (Normal Response for INITIALIZE command)
%007002078<CR>	All of above but selftest failed/ROM failed.

RESET

Resets the 926 to the state just after power is applied. This command responds with a % response that indicates power-up just occurred.

SET_DATA count

Sets all channels of spectral data in the window-of-interest (see SET_WINDOW command) for the currently selected device (see SET_DEVICE command) to the specified count. ROI flags are not affected.

SET_GAIN_CONVERSION chans

Sets the conversion gain. The conversion gain defines the number of channels within the device that will used for spectral data. This has the effect of altering the resolution of the ADC from 13/11 bits (conversion gain = 8192/2048) to 9 bits (conversion gain = 512) for the device.

Legal Commands:

SET_GAIN_CONVERSION 0<CR>	Conversion gain set to default (8192)
SET_GAIN_CONVERSION 512<CR>	Conversion gain set to 512 channels
SET_GAIN_CONVERSION 1024<CR>	Conversion gain set to 1024 channels
SET_GAIN_CONVERSION 2048<CR>	Conversion gain set to 2048 channels
SET_GAIN_CONVERSION 4096<CR>	Conversion gain set to 4096 channels
SET_GAIN_CONVERSION 8192<CR>	Conversion gain set to 8192 channels

SET_GATE_ANTICOINCIDENT

Causes the MCB to expect the ADC gate input signal in anticoincident mode. See the section on the ADC gate input for more information. See also SET_GATE_OFF, SET_GATE_COINCIDENT, and SHOW_GATE.

SET_GATE_COINCIDENT
Causes the MCB to expect the ADC gate input signal in coincident mode. See the section on the ADC gate input for more information. See also SET_GATE_OFF, SET_GATE_ANTICOINCIDENT, and SHOW_GATE.

SET_GATE_OFF
Causes the MCB to ignore the state of the ADC gate input signal. See the section on the ADC gate input for more information. See also SET_GATE_COINCIDENT, SET_GATE_ANTICOINCIDENT, and SHOW_GATE.

SET_INTEGRAL_PRESET count
Sets the ROI integral preset to the specified count. During data acquisition when the sum of the counts contained in the channels of a device that have the ROI flag set reaches the integral preset count, the preset is complete and the acquisition is stopped. The actual number of counts in the ROI integral may exceed the preset value by up to 512 counts due to the pipelined architecture of the 926. Setting an integral preset to 0 counts disables the preset. The integral preset may be set to from 0 (disabled) to 4294967295 counts. See also CLEAR_PRESETS and SHOW_INTEGRAL_PRESET.
Execution Errors:
%131135083<CR> The command was attempted while spectrum acquisition was in progress. No action was taken.

SET_LIVE_PRESET ticks
Sets the live-time preset to the specified number of ticks. During data acquisition when the live-time counter reaches the preset number of ticks, the preset is complete and the acquisition is stopped. Setting a live-time preset to 0 ticks disables the preset. See also CLEAR_PRESETS and SHOW_LIVE_PRESET.
Execution Errors:
%131135083<CR> The command was attempted while spectrum acquisition was in progress. No action was taken.

SET_PEAK_PRESET count
Sets the ROI peak preset to the specified count. During data acquisition when the contents of any channel of a device that has the ROI flag set reaches the peak preset count, the preset is complete and the acquisition is stopped. The actual number of counts in the ROI peak may exceed the preset value by a small number of counts due to the pipelined architecture of the 926. Setting a peak preset to 0 counts disables the preset. The peak preset may be set to from 0 (disabled) to 2147483647 counts. See also CLEAR_PRESETS and SHOW_PEAK_PRESET.
Execution Errors:
%131135083<CR> The command was attempted while spectrum acquisition was in progress. No action was taken.

SET_ROI start_chan,number_of_chans
Sets the ROI flags for the specified channels. This command can be used multiple times to set ROI flags without affecting previously set flags. ROI flags specify channels within a device that are considered for ROI integral and ROI peak presets.

SET_TRUE_PRESET ticks
Sets the true-time preset to the specified number of ticks. During data acquisition when the true-time counter reaches the preset number of ticks, the preset is complete and the acquisition is stopped. Setting a true-time preset to 0 ticks disables the preset. See also CLEAR_PRESETS and SHOW_TRUE_PRESET.
Execution Errors:
%131135083<CR> The command was attempted while spectrum acquisition was in progress. No action was taken.

SET_WINDOW [start, length]

Sets the window-of-interest to the specified start channel and number of channels. The channels of spectral data in the window-of-interest are affected by commands such as CLEAR and SET_DATA. If neither start or length is provided, the window is set to the maximum size allowed by the conversion gain specified for the currently selected device. The window-of-interest is always set to the maximum size after a SET_DEVICE command or a SET_SEGMENT command.

Execution Errors:

%131128085<CR> The start channel was too high for the conversion gain.

%131129086<CR> The length specified one or more channels that were too high for the currently selected device's conversion gain.

%131132080<CR> The start channel was specified without a length. If one value is given the other must be also given.

SHOW_ACTIVE

Returns a 1 if the ADC is active, acquiring spectral data, or 0 if it is not active.

Responses:

$C00000087<CR> The ADC is not active.

$C00001088<CR> The ADC is active.

SHOW_ALARM

Returns a record that indicated whether the alarm responses are enabled or disabled.

Responses:

$IT<CR> Alarms are enabled.

$IF<CR> Alarms are disabled.

SHOW_CONFIGURATION

Returns a record that indicates the hardware configuration of the MCB. The record contains information about the number of segments in an MCB device (always one for the 926), and the current conversion gain for each segment. The record is organized as follows:

$J0819200001aaaaa00000" 65 zeros here for total of 75 zeros "00000ccc for 8K
$J0204800001aaaaa00000" 65 zeros here for total of 75 zeros "00000ccc for 2K

Where **aaaaa** represents the conversion gain for the one and only segment in the currently selected device, and **ccc** represents the record checksum. See the section on response records in this appendix for more information about response records and checksums.

SHOW_GAIN_CONVERSION

This command returns the conversion gain.

Responses:

$C00512095<CR> Conversion gain reported as 512 channels

$C01024094<CR> Conversion gain reported as 1024 channels

$C02048101<CR> Conversion gain reported as 2048 channels

$C04096106<CR> Conversion gain reported as 4096 channels (8K only)

$C08192107<CR> Conversion gain reported as 8192 channels (8K only)

SHOW_GATE

Reports the current mode of operation of the ADC gate input. See also SET_GATE_OFF, SET_GATE_COINCIDENT, and SET_GATE_ANTICOINCIDENT.

Responses:

$FOFF<CR> Reports the ADC gate is off or ignored.

$FCOI<CR> Reports the ADC gate is in coincident mode.

$FANT<CR> Reports the ADC gate is in anticoincident mode.

SHOW_INTEGRAL [start_chan,number_of_chans]

Reports the sum of the specified group of spectral data channels. If start_chan and number_of_chans is not provided, SHOW_INTEGRAL reports the sum of all channels that have their ROI flag set.

Responses:

$G0000000000075<CR>	Integral reported as 0
...	**...**
$G4294967294131<CR>	Integral reported as 4294967294
$G4294967295132<CR>	Integral reported as greater than or equal to 4294967295 (maximum reportable value)

SHOW_INTEGRAL_PRESET

Reports the current ROI integral preset value. See SET_INTEGRAL_PRESET for more information about the ROI integral preset. See also SHOW_INTEGRAL.

Responses:

$G0000000000075<CR>	Integral preset reported as 0
...	**...**
$G4294967295132<CR>	Integral reported as 4294967295

SHOW_LIVE

Reports the contents of the live-time counter in units of 20 milliseconds (50 ticks per second). See also CLEAR_COUNTERS and SET_LIVE.

Responses:

$G0000000000075<CR>	Live time reported as 0 ticks
$G0000000001076<CR>	Live time reported as 1 tick (20 milliseconds)
...	**...**
$G4294967295132<CR>	Live time reported as 4294967295 ticks (over 23000 days)

SHOW_LIVE_PRESET

Reports the current live-time preset in units of 20 milliseconds (50 ticks per second). See also CLEAR_PRESETS and SET_LIVE_PRESET.

Responses:

$G0000000000075<CR>	Live-time preset reported as disabled
$G0000000001076<CR>	Live-time preset reported as 1 tick
...	**...**
$G4294967295132<CR>	Live-time preset reported as 4294967295 ticks

SHOW_MODE

This command is for compatibility with Model 918 systems. It always reports that the 926 operates in pulse-height analysis mode.

Responses:

$FPHA<CR>

SHOW_NEXT

Used in conjunction with the SHOW_ROI command, SHOW_NEXT reports the next continuous group of channels that have the ROI flag set. The response is of the form:

$Dssssnnnnnccc<CR> where sssss represents an integer number that is the number of the first channel of the "next" group of channels that all have their ROI bit set, and nnnnn represents an integer number that is the number of channels in the group. If no more channels have their ROI bit set, SHOW_NEXT returns a first channel of 0 and a number of channels of 0. The SHOW_ROI command is used to report the "first" group of channels that all have their ROI bit set.

Example Responses:

$D0100000050078<CR>	Next ROI group starts at chan 1000 and is 50 chans long.
$D0215000150086<CR>	Next ROI group starts at chan 2150 and is 150 chans long.
$D0000000000072<CR>	No other ROI groups to report

SHOW_OVERFLOW_PRESET

Reports the state of the overflow preset.

Responses:

$IT<CR>	Overflow preset enabled
$IF<CR>	Overflow preset disabled

SHOW_PEAK

This command returns the contents of the ROI channel with the largest number of counts. An ROI channel is a channel that has the ROI flag set. The maximum possible value is 2147483647, which is the maximum number of counts that can be stored in a 31-bit channel.

Responses:

$G0000000000075<CR>	Maximum count in an ROI channel is zero or no ROI channels were found.
$G0000000001076<CR>	Maximum count in an ROI channel is 1.
...	**...**
$G2147483646120<CR>	Maximum count in an ROI channel is 2147483646.
$G2147483647121<CR>	Maximum count in an ROI channel is 2147483647.

SHOW_PEAK_CHANNEL

This command returns the number of the ROI channel with the largest number of counts. An ROI channel is a channel that has the ROI flag set. The lowest number ROI channel with the largest count is reported if more that one channel contains the largest number of counts. Channel 16383 is the highest numbered channel in any device.

Responses:

$C00000087<CR>	Maximum count was found in channel 0 or no ROI channels were found.
$C00001088<CR>	Maximum count was found in channel 1.
...	**...**
$C08190105<CR>	Maximum count was found in channel 8190.
$C08191106<CR>	Maximum count was found in channel 8191.

SHOW_PEAK_PRESET

Reports the value of the ROI peak preset. See SET_PEAK_PRESET for information about the ROI peak preset.

Responses:

$G0000000000075<CR>	Peak preset disabled
$G0000000001076<CR>	Peak preset set to 1 count
...	**...**
$G2147483646120<CR>	Peak preset set to 2147483646 counts
$G2147483647121<CR>	Peak preset set to 2147483647 counts

SHOW_ROI

Used in conjunction with the SHOW_NEXT command, SHOW_ROI reports the first continuous group of channels that have the ROI flag set. The response is of the form: **$Dssssnnnnnccc<CR>** where sssss represents an integer number that is the number of the first channel of the "first" group of channels that all have their ROI bit set, and nnnnn represents an integer number that is the number of channels in the group. The SHOW_NEXT command is used to report the "next" group of channels that all have their ROI bit set.

Responses:

$D0100000050078<CR>	First ROI group starts at chan 1000 and is 50 chans long.
$D0215000150086<CR>	First ROI group starts at chan 2150 and is 150 chans long.
$D0000000000072<CR>	No ROI groups to report

SHOW_TRUE

Reports the contents of the true-time counter in units of 20 milliseconds (50 ticks per second). See also CLEAR_COUNTERS and SET_TRUE.

Responses:

$G0000000000075<CR>	True time reported as 0 ticks
$G0000000001076<CR>	True time reported as 1 tick (20 milliseconds)
...	**...**
$G4294967295132<CR>	True time reported as 4294967295 ticks (over 23000 days)

SHOW_TRUE_PRESET

Reports the current true-time preset in units of 20 milliseconds (50 ticks per second). See also CLEAR_PRESETS and SET_TRUE_PRESET.

Responses:

$G0000000000075<CR>	True-time preset reported as disabled
$G0000000001076<CR>	True-time preset reported as 1 tick
...	**...**
$G4294967295132<CR>	True-time preset reported as 4294967295 ticks

SHOW_VERSION

Reports the firmware version number in the form: **Fmmmm-vvv<CR>**
where **mmmm** is a 4-character model designator and **vvv** is a 3-character version designator.

Example Responses:

$F0926-001<CR>	Model 926 firmware version 1 reported

SHOW_WINDOW

Reports the start channel and number of channels that are in the window of interest for the currently selected device in the form: **$Dxxxxxyyyyyccc<CR>** where **xxxxx** is the start channel (0 through 8191) and **yyyyy** is the number of channels (1 through 8192). See SET_WINDOW for more information about the window-of-interest.

<u>Example Responses:</u>

$D0000008192092<CR>	Window of interest reported as starting at channel 0 and continuing for 8192 channels.

START [seg-mask]

Starts the acquisition of spectral data. The optional segment mask is provided for compatibility with other MCBs and may be any value from 0 to 65535 but is ignored by the Model 926.

<u>Execution Warnings:</u>

%000005074<CR>	The acquisition is already started (no changes made).
%000006075<CR>	A preset was exceeded (acquisition was not started).

STOP [seg-mask]

Stops the acquisition of spectral data. The optional segment mask is provided for compatibility with other MCBs and may be any value from 0 to 65535 but is ignored by the Model 926.

<u>Execution Warnings:</u>

%000005074	Acquisition already stopped (no changes made

TEST mask

Performs any combination of the internal selftests where mask represents a 16-bit integer with each bit set specifying a test as follows:

Bit 0 (LSB):	ROM checksum test (nondestructive)
Bit 1:	Spectral data memory test (destroys spectral data)
Bit 2:	Processor memory test (destroys spectral data)
Bit 3:	RESERVED
Bit 4:	RESERVED
Bit 5:	Mailbox memory test (may cause mailbox comm error)

<u>Execution Errors:</u>

%004002075<CR>	ROM failed test
%004008081<CR>	Processor Memory failed test
%004016080<CR>	Spectral Data Memory or Mailbox Memory failed test

The actual response record may be a combination of any of the above records depending on the selftests performed. For example:

%004010074<CR>	Processor Memory and ROM1 both failed test

APPENDIX B. GLOSSARY

ACQUISITION

The process of collecting data from a detector and storing the data in memory.

ALARM RESPONSE RECORD

The response record that is sent to the host computer when one or more devices are stopped.

ASCII

American Standard Code for Information Interchange. The ASCII code is defined by ANSI (American National Standards Institute) Standard X3.4 - 1977. This standard describes the representation of characters as 8-bit binary numbers. This representation for characters is used by most mini and personal computers.

CHECKSUM
The sum of bytes in a record used to detect when communication errors occur.

CLOCK
A component of a device that keeps track of some form of time. 926 MCBs have live-time and true-time clocks.

COUNTER
Another name for a 926 clock (live-time or true-time).

DEAD TIME
The time that data acquisition is active but the MCB cannot process detector pulses (is dead). Dead time is equal to the true time minus the live time for a device.

DEVICE
The entity within an MCB that collects and stores spectral data. A device corresponds to the MCB's inputs. Model 919 MCBs have 4 inputs and thus 4 devices, while 926 MCBs have only 1 input and thus 1 device. A device can be started, stopped, cleared, and selected.

HOST
The computer that sends commands to an MCB and receives responses from the MCB.

LIVE TIME
The time that data acquisition is active and the MCB is capable of processing detector pulses (is live). Live time is equal to the true time minus the dead time for a device.

PRESET
A limit set for a clock or region-of-interest count that if exceeded during an acquisition will cause the acquisition to stop. 926 MCBs have live time, true time, ROI integral, ROI peak, and overflow presets for each device in the MCB.

PROGRAM MEMORY
The ROM memory inside the 926 MCB that contains the microprocessor instructions and fixed data that control the operation of the MCB.

RAM
Random Access Memory.

RECORD
A sequence of related bytes. 926 command, percent, and dollar records are composed of printable ASCII characters and end with an ASCII carriage return.

ROI CHANNEL
A channel that has the ROI flag set.

ROI FLAG
A set of internal MCB flags (one for each channel) which, when set, identifies the channel as being part of the region-of-interest. All channels in a device that have the ROI flag set are considered when ROI integral or ROI peak presets are evaluated.

ROM
Read-Only Memory.

SCRATCHPAD MEMORY

The RAM memory inside the 926 MCB that is used for various overhead operations. The scratchpad memory is all the memory that is not used for storage of spectral data or mailbox communications.

SEGMENT

A subdivision of a device. Segments are not implemented on 926 MCBs and are referenced only for compatibility with other MCBs.

SELFTEST

A test of internal MCB components initiated by the TEST command or MCB power-up..

TICK

The minimum unit of time associated with a clock such as the real-time or live-time clocks — a clock tick.

TRUE (REAL) TIME

The actual time that data acquisition is active regardless of the MCB's ability to process detector pulses. True time is also known as real time.

WINDOW-OF-INTEREST

The continuous group of channels affected by commands like CLEAR and SET_DATA. The window-of-interest is set by the SET_WINDOW command, as well as by the SET_DEVICE and SET_SEGMENT commands.

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